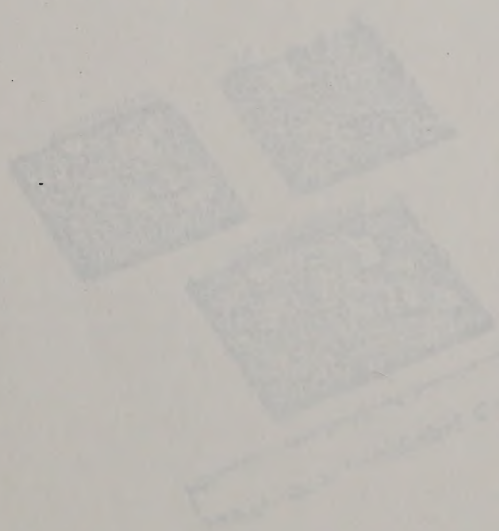
SECTION VII.

MODEM DATA SHEETS

MICROPHONE DATA SHEETS



Rockwell

MODEM PRODUCTS DATA SHEET

R24 2400 BPS INTEGRAL MODEM

R24 2400 BPS INTEGRAL MODEM

INTRODUCTION

The Rockwell R24 is a high performance synchronous serial 2400 bps DPSK modem. Utilizing extensive MOS/LSI technology, the R24 is implemented in three modular building blocks. It is innovatively designed to enable its economic integration by system designers in a broad range of communication, computer, and control equipment.

Having Bell 201 B/C and CCITT V.26 compatibility, the modular R24 offers the user sufficient flexibility to customize a 2400 bps modem to his specific packaging and functional requirements. With a minimum amount of interface circuitry, the modem can be configured for operation on leased lines or on the general switched network.

MODULE VERSATILITY

The versatility of the R24 design is achieved by dividing the modem's functions into three modules:

Transmitter — Module T
Receiver — Modules R1, R2

Each module can be plugged into standard connectors or can be wave soldered on one or more printed circuit boards. The pin spacing is on 100 mil centers. Modem modules are functionally independent.

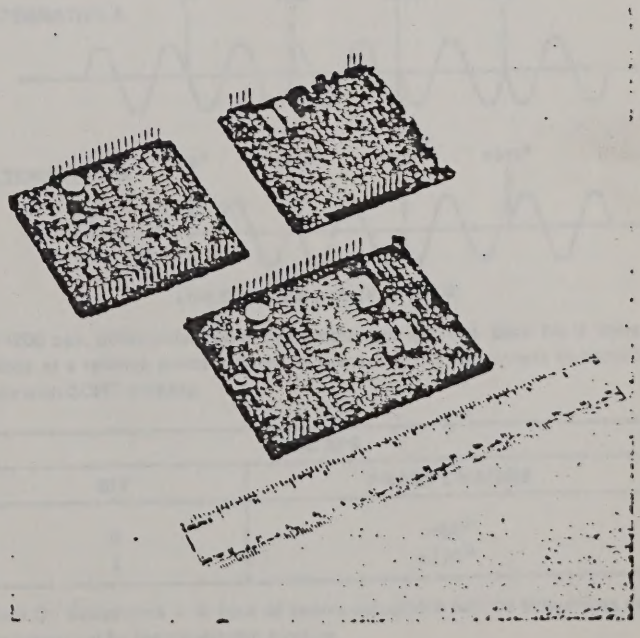
MODEM OPERATION MODES

In general, the modules can be configured to operate in the following modes:

Simplex — Transmit only:	Only the transmitter module (T) is used.
Simplex — Receive only:	R1 and R2 modules are used to implement a complete receiver function.
Half Duplex (2-Wire):	Requires both transmit and receive functions (although not simultaneously), therefore, all three modules are used.
Full Duplex (4-Wire):	Requires both transmit and receive functions simultaneously, again all three modules are used.

FEATURES/BENEFITS

- LSI high density; low power
- 2400/1200 bps modes
- Transmitter-Differential phase modulation
- Receiver-Coherent phase detection
- Bell 201 B/C, CCITT V.26 compatible
- CCITT A/B encoding options
- Operating modes:
  - Half duplex (2 wire)
  - Full duplex (4 wire)
  - Simplex (Transmit or Receive only)
- Outstanding performance over unconditioned lines
- LSTTL/CMOS compatible digital interface
- Fixed compromise equalizer
- V.27 compatible scrambler/descrambler
- Answer-back tone generation
- Clear-to-send delay options
- New sync option provides rapid resynchronization
- Typical power consumption 2 watts
- Total module area 25 sq. in.
- R24 Modem Evaluation Board facilitates evaluation and design-in tasks.



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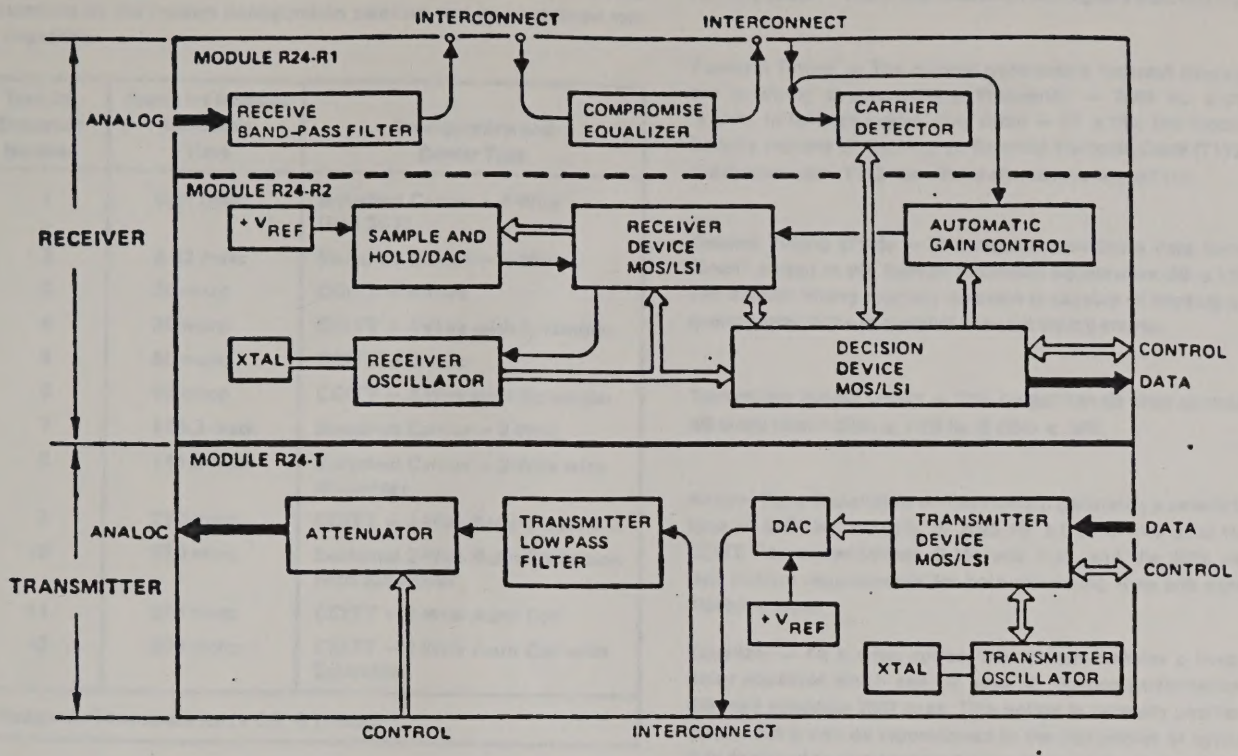
Rev. 2, March 1981



R24 Functional Diagram

TECHNICAL DESCRIPTION

Transmitter carrier frequency ..... 1800 Hz ± 0.01%

Echo suppression and answer tone frequencies — 2100 Hz ± 0.01% or 2025 Hz ± 0.01%

Received signal frequency tolerance — The receiver can adapt to received frequency errors up to ± 10 Hz with less than a 0.5 dB degradation in bit error rate.

Data signaling and modulation rate:

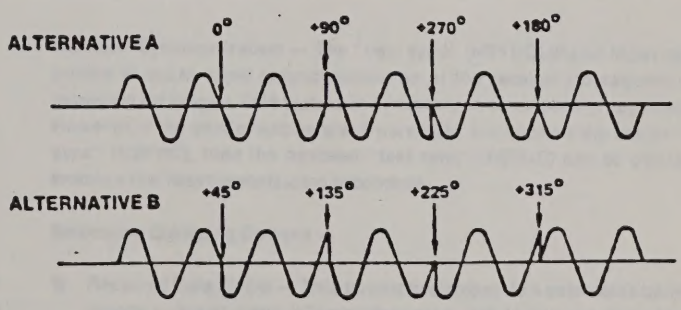
1) Normal: Signaling Rate — 1200 baud ± 0.01%.
   Data Rate — 2400 bps ± 0.01%
2) Fallback: Signaling Rate — 1200 baud ± 0.01%.
   Data Rate — 1200 bps ± 0.01%.

Transmitted Data Spectrum — The transmitted spectrum's bandwidth extends from 800 Hz to 2800 Hz. Phase distortion characteristics are within the limits specified in CCITT Recommendation V.26 bis. The out of band signal power limitations meet those specified by Part 68 or Tariff 261 of the FCC's regulations, and typically exceed the requirements of international regulatory bodies as well.

Data Encoding (DPSK) — At 2400 bps, differential four-phase modulation is used. The data stream is transmitted in pairs of consecutive bits (dibits). Each dibit is encoded as a phase change relative to the phase of the preceding signal element.

The R24 implements the phase A and B recommendations of CCITT V.26. The modulation coding in Bell 201 modems is the same as V.26B. Definition of these coding arrangements is shown in the following table:

2400 BPS		
DIBIT	PHASE CHANGE	
	V.26A	V.26B/Bell 201
0 0	0°	+45°
0 1	+90°	+135°
1 1	+180°	+225°
1 0	+270°	+315°



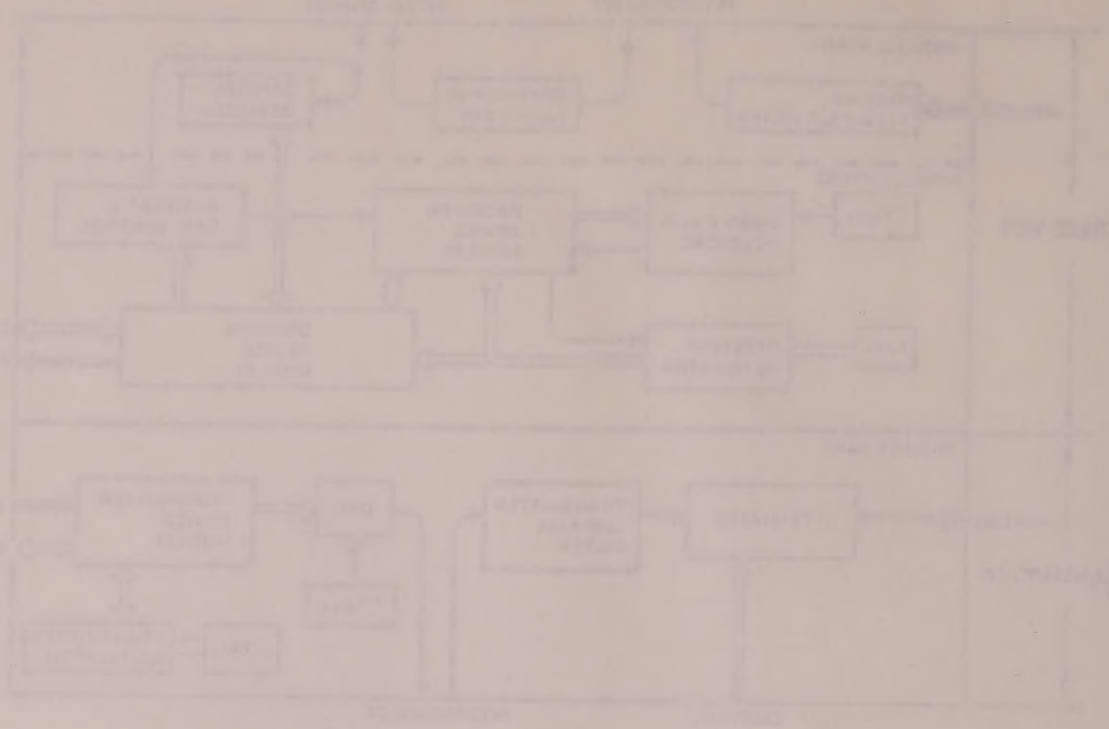
Line Signal Diagram (V.26 A & B)

At 1200 bps, differential two-phase modulation is used. Each bit is transmitted at a relative phase change to preceding signal element in accordance with CCITT V.26 bis.

1200 BPS	
BIT	PHASE CHANGE
0	+90°
1	+270°

Turn On Sequences — A total of twelve selectable turn on sequences can be generated by the transmitter module.

Turn Off Sequence — When the transmitter has been sending data and "Request to Send" is turned off, any remaining data bit information is transmitted within 6 milliseconds.



Ready for Sending (T106) Response Times — These response times are determined by the modem configuration selected and its associated turn on sequence.

Turn On Sequence Number	Ready for Sending Response Time	Configuration and Carrier Type
1	6.67 msec	Switched Carrier — 4-Wire (Bell 201)
2	8.33 msec	Switched Carrier — 4-Wire
3	30 msec	CCITT — 4-Wire
4	30 msec	CCITT — 4-Wire with Scrambler
5	90 msec	CCITT — 2-Wire
6	90 msec	CCITT — 2-Wire with Scrambler
7	148.3 msec	Switched Carrier — 2-Wire
8	148.3 msec	Switched Carrier — 2-Wire with Scrambler
9	220 msec	CCITT — 2-Wire Echo Protection
10	220 msec	Switched 2-Wire Echo Protection with Scrambler
11	800 msec	CCITT — 2-Wire Auto Call
12	800 msec	CCITT — 2-Wire Auto Call with Scrambler
Response Time tolerance (+0.9, -0.1) msec		

Scrambler/Descrambler — As a selectable option, the scrambler/descrambler may be inserted into the transmitter/receiver path. The purpose of this scrambler is to ensure that the line signal will evenly span the allocated bandwidth. This minimizes pattern sensitivity problems arising from simple fixed and periodic data sequences. The scrambler is V.27 or V.27 bis/ter compatible.

Carrier Detect (T109) — The modem receiver incorporates a line signal energy detector whose output responds to three selectable threshhold levels.

Set 1 (V.26 bis, switched network) — Greater than -43 dBm = ON
Less than -48 dBm = OFF

Set 2 (V.26 bis, switched network) — Greater than -33 dBm = ON
Less than -38 dBm = OFF

Set 3 (V.26, leased line) — Greater than -26 dBm = ON
Less than -31 dBm = OFF

NOTE: A minimum hysteresis of 2db exists between the actual turn-on and turn-off transition levels for each threshhold set.

Selectable T109 Response Times — This time is defined as the interval between the sudden connection or removal of the received line signal to the modems receive filter, and the subsequent transition of Carrier Detect (T109) from one state to the other.

Carrier Detect Transition	Response Time
OFF to ON (connection)	6 ±1 ms / 14 ±1 ms } Selectable
ON to OFF (removal)	8 ±3 ms / 22 ±3 ms } Selectable

Receive Level — The modem receives line signals from 0 to -43 dBm.

Transmit Timing — The modem generates a Transmit Clock (T114) having the following characteristics: Frequency — 2400 Hz ±.01% (1200 Hz ±.01% in fallback mode), duty cycle — 50 ±1%. The modem is also optionally capable of tracking an External Transmit Clock (T113) supplied by the modem user. T113 has similar characteristics to T114.

Receive Timing (T115) — The modem provides a data derived "Receive Clock" output in the form of a nominal squarewave (50 ±1% duty cycle). The modem timing recovery function is capable of tracking a ±0.01% frequency error in the associated transmit timing source.

Transmitter Output Levels — This output can be strap controlled in 2 ±0.2 dB steps from-1 dBm ± 1 dB to-15 dBm ± 1dB.

Answer Tone Generation — The modem generates a selectable answering tone of 2100 Hz ±0.01% or 2025 Hz ±0.01%. The 2100 Hz tone meets CCITT Recommendations G.161 and V.25, and the 2025 Hz tone meets Bell System requirements for both answering tone and echo suppressor disabling tone.

Equalizer — As a strap option, the modem contains a fixed compromise delay equalizer which can be used to improve performance over unconditioned schedule 3002 lines. This option is normally positioned in the receiver, but it can be repositioned in the transmitter or bypassed entirely. It is designed to compensate for the mean of the range of group delay distortions generally encountered in the United States. Its amplitude response is nominally flat at 0.0 dB.

Test Pattern Generation—The scrambler/descrambler function can be used to implement a 127-bit test pattern feature. For example, a constant mark input could be scrambled and transmitted as a pseudo-random signal to be descrambled at the receiver back to the constant mark. A transmission error would be represented as a space for the duration of an incorrect bit.

Multipoll Synchronization — The "new sync" (NSYNC) digital input can be pulsed to cause rapid resynchronization of the receiver for sequences of incoming messages. This feature is necessary in some polling applications. However, if the user's hardware/software does not support the use of "new sync" (NSYNC), then the optional "fast sync" (FSYNC) can be utilized to enable a fast resynchronization procedure.

Selectable Clamping Options —

1) Received Data (T104) — This output is clamped to a selectable constant (space or mark) when "Carrier Detect" is off, to prevent disturbances on the line from getting through the receiver to the data output.

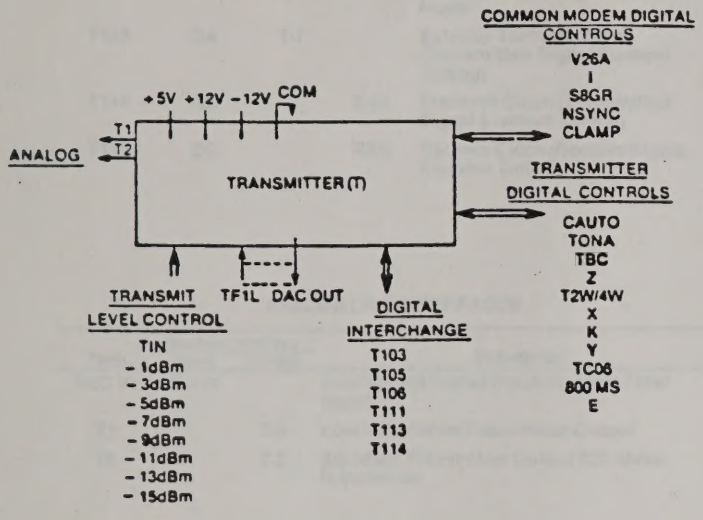
2) Carrier Detect (T109) Clamp — This output may be clamped OFF (squelched) in 2-wire applications during the time when "Request to Send" (T105) is on. An additional option extends this clamp for 148 msec beyond T105 transitioning off, providing echo protection.

3) Receive Clock (T115) — This clock output can be clamped OFF when "Carrier Detect" is off, thereby preventing any disturbances from propagating through the receiver to the receive clock output.

SYSTEM DESIGN

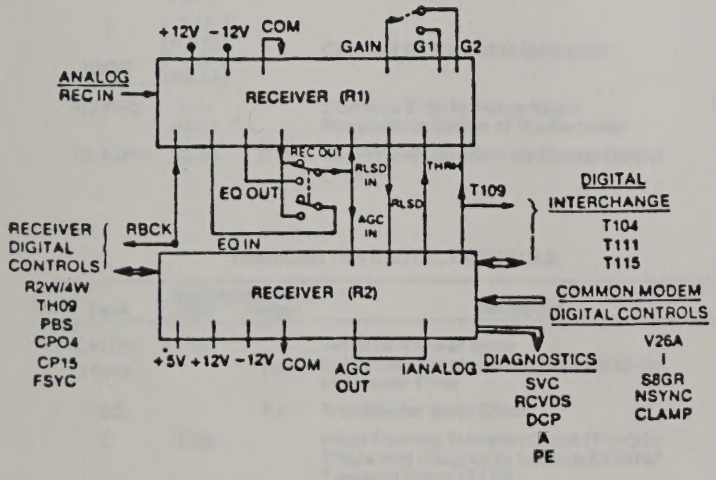
The R24 modem modules provide the user with sufficient flexibility to implement a wide range of modem functional configurations. This flexibility is achieved by digital control at the module interfaces. For a given application, such as a lease network V.26 Alternative B modem (Bell 201B), the complexity of the user interface can be significantly reduced by strapping those data interface inputs which do not change. The modem interface can also be under software control.

Figures 1 and 2 show the basic interface connections for the transmitter module (T) and the receiver modules (R1,R2). These diagrams are applicable for any operation mode of the modem-simplex, half-duplex, or full-duplex.



TRANSMITTER INTERFACES

Figure 1



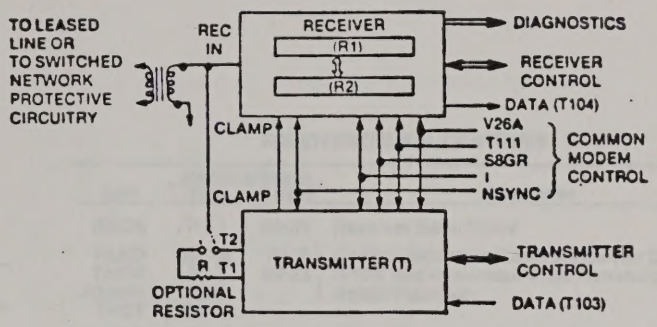
RECEIVER INTERCONNECTION

Figure 2

MODEM OPERATION — HALF OR FULL-DUPLEX

Figure 3 indicates the module interconnections necessary for half-duplex operation. For full-duplex operation, the transmitter/receiver interconnections are similar to the half-duplex case with the exception that "REC IN" is not connected to T2 or T1. In full-duplex operations, the transmission and receiver paths are independent.

As shown in the diagram, a transformer is sufficient to connect directly to a leased line in the U.S. For the switched network, registered protective circuitry or a data access arrangement (DAA) is generally required. Rockwell offers an FCC registered protective circuitry product to support this application. Requirements for line interface and protective circuitry vary internationally.

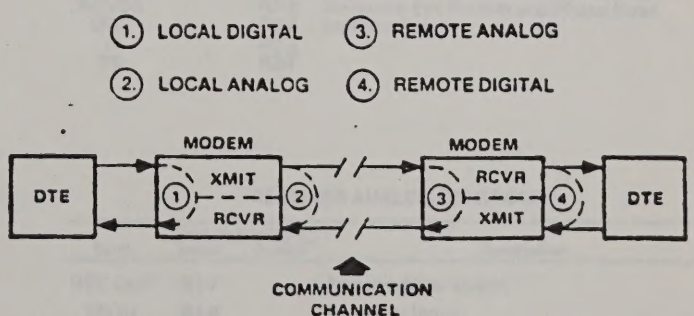


TRANSMITTER-RECEIVER INTERCONNECTION
(HALF DUPLEX)

Figure 3

Secondary Channel — The modem modules provide the user with all the interface connections needed to add an external secondary channel if required. This data transmission channel would operate at a lower rate, and in a different portion of the available bandwidth than the primary. Additional external receive filtering would also have to be added to allow simultaneous operation of the primary and secondary channels.

Analog and Digital Loopback — To check out or diagnose the communication link, loopback testing is often performed. A test word is transmitted and "looped" back to the originating DTE. Typical types of loopback tests are:



DTE - Data Terminal Equipment

The modem modules provide the user with all the necessary interface connections to implement almost any loopback scheme desired. With a minimum amount of external circuitry, loopback testing can be controlled via a communications adapter/software approach or manually. For local analog, remote analog and remote digital loopback, the V.27 scrambler within the modem can be used to generate a 127-bit word.

INTERFACE DESCRIPTION

STANDARD DIGITAL INTERCHANGE

Term (CCITT V.24 Equivalent)	EIA RS232C Equivalent	Module Interface Input	Module Interface Output	Description
T103	BA	T-9		Transmitted Data
T104	BB		R2-5	Received Data
T105	CA	T-8		Request to Send
T106	CB		T-6	Ready for Sending (Clear to Send)
T109	CF	R1-4	R2-22	Data Channel Received Line Signal Detector (Carrier Detect)
T111	CH	T-12, R2-9		Data Signalling Rate Selector Selects 2400 bps or 1200 bps Mode
T113	DA	T-7		External Transmit Clock (Transmitted Signal Element Timing)
T114	DB		T-10	Transmit Clock (Transmitted Signal Element Timing)
T115	DD		R2-6	Receive Clock (Receive Signal Element Timing)

ANALOG LINE INTERFACES

Term	Module Interface Input	Module Interface Output	Description
REC IN	R1-12		Analog Line Signal Input (Receive Filter Input)
T1		T-1	Low Impedance Transmitter Output
T2		T-2	Standard Transmitter Output 600 ohms Impedance

COMMON MODEM DIGITAL CONTROLS

Term	Module Interface Input	Module Interface Output	Description
V26A	T-16 R2-13		Selects V.26A or V.26B Dibit Encoding
I S8GR	T-15, R2-12, T-17, R2-14		Controls for Scramble Operation
NSYNC	T-14 R2-11		Controls T109 to Force Rapid Resynchronization of the Receiver
CLAMP	R2-10	T-13	Implements Squelch for Carrier Detect (T109)

TRANSMITTER DIGITAL CONTROLS

Term	Module Interface Input	Module Interface Output	Description
CAUTO	T-3		Initiates Answer Tone
TONA		T-5	Indicates Completion of Transmission of Answer Tone
TBC		T-4	Transmitter Baud Clock
Z	T-28		Input Forcing Transmit Clock (T114) to Phase and Frequency Lock to External Transmit Clock (T113)
T2W/4W	T-11		Inputs Affecting Ready for Sending Response Times, Answer Tone Frequency and Carrier Detect (T109) Squelch
X	T-24		
K	T-25		
Y	T-26		
TC06	T-27		
800MS	T-29		
E	T-30		

TRANSMITTER ANALOG CONTROLS

Term	Module Interface Input	Module Interface Output	Description
DAC OUT		T-22	Output of Digital to Analog Converter
TFIL	T-23		Input to Low Pass Filter. DAC OUT is Normally Connected to TFIL Unless Additional Filtering or an Equalizer is to be Inserted.
TIN	T-31		These Nine Signals Implement the Transmitter Output Level Attenuator. One of the Signals – 1dBm, . . . , – 15dBm is Strapped to TIN to Set the Desired Output Level.
– 1dBm		T-39	
– 3dBm		T-38	
– 5dBm		T-37	
– 7dBm		T-36	
– 9dBm		T-35	
– 11dBm		T-34	
– 13dBm		T-33	
– 15dBm		T-32	

RECEIVER DIGITAL CONTROLS

Term	Module Interface Input	Module Interface Output	Description
RBCK	R1-1	R2-25	Receiver Baud Clock
RLSD	R2-24	R1-2	Control Signals to Generate Carrier Detect (T109) and Implement T109 Threshold Set Select Function
THRH	R1-3	R2-23	
R2W/4W	R2-8		
TH09	R2-18		
TC09	R2-15		Determines Carrier Detect (T109) Off-to-On Response
PBS	R2-16		Determines Carrier Detect (T109) On-to-Off Response
CP04	R2-17		Clamps Received Data (T104) to a mark or space when Carrier Detect (T109) is Off
CP15	R2-19		Optional Clamping of Received Clock (T115)
FSYC	R2-20		Fast Sync Optional Fast Resynchronization Procedure

RECEIVER DIGITAL DIAGNOSTICS

Term	Module Interface Input	Module Interface Output	Description
SYC		R2-1	Digital Outputs which Enable User to Generate Eye Pattern and Phase Error Information
RCVDS		R2-2	
DCP		R2-4	
A		R2-3	
PE		R2-7	

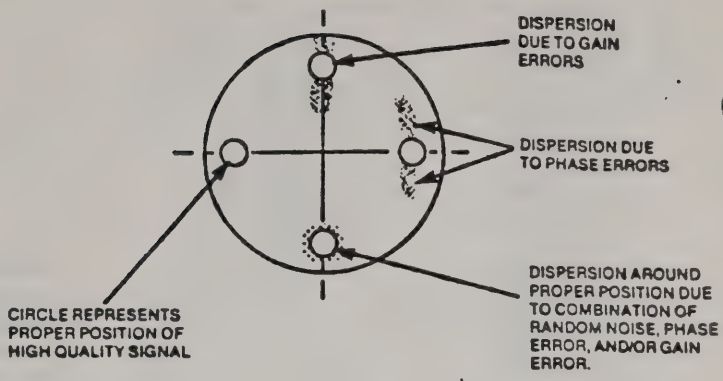
RECEIVER ANALOG CONTROLS

Term	Module Interface Input	Module Interface Output	Description
REC OUT	R1-7		Receive Filter Ouput
EQ IN	R1-8		Equalizer Input
EQ OUT	R1-6		Equalizer Output
RLSD IN	R1-5		Carrier Detect Circuitry Input
AGC IN	R2-21		Automatic Gain Control Circuitry Input
AGC OUT		R2-26	Automatic Gain Control Circuitry Output
GAIN		R1-10	Optional Carrier Detect (T109) Threshold Selection Controls
G1	R1-11		
G2	R1-9		
IANALOG	R2-27		Sample and Hold Circuitry Input

MODEM PERFORMANCE

The R24 is a high performance synchronous 2400 bps DPSK modem, utilizing a coherent demodulation technique to achieve reliable operation over the switched network or unconditioned lines. This section contains a quantitative discussion of the R24's typical performance under varying test conditions.

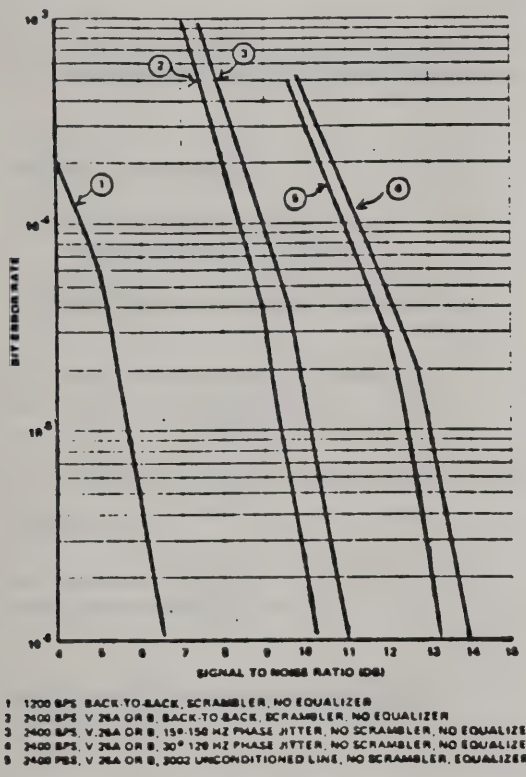
Timing Jitter — The maximum steady state timing jitter of "receive clock" with respect to "transmit clock" is less than 10% p-p for an input signal-to-noise ratio of 12 dB.


DISPERSION DUE TO GAIN ERRORS
DISPERSION DUE TO PHASE ERRORS
DISPERSION AROUND PROPER POSITION DUE TO COMBINATION OF RANDOM NOISE, PHASE ERROR, AND/OR GAIN ERROR.
CIRCLE REPRESENTS PROPER POSITION OF HIGH QUALITY SIGNAL

Typical Eye Pattern: 4 Phase-2400 bps-1200 Baud (V26A)

Phase error and eye pattern can be extremely useful for modem acceptance testing, product evaluation, and observation of line signal quality under actual operation.

Bit Error Rate — The following graph represents typical R24 performance:


BIT ERROR RATE
SIGNAL TO NOISE RATIO (DB)
1 1200 BPS BACK-TO-BACK, SCRAMBLER, NO EQUALIZER
2 2400 BPS V 26A OR B, BACK-TO-BACK, SCRAMBLER, NO EQUALIZER
3 2400 BPS, V.26A OR B, 150-150 HZ PHASE JITTER, NO SCRAMBLER, NO EQUALIZER
4 2400 BPS, V 26A OR B, 30° 120 HZ PHASE JITTER, NO SCRAMBLER, NO EQUALIZER
5 2400 PBS, V 26A OR B, 3002 UNCONDITIONED LINE, NO SCRAMBLER, EQUALIZER

Typical Bit Rate Performance

Phase Error — Phase error can be measured by using the modem's output signals PE, SYC, and A. With an external test circuit, a numerical value can be derived to indicate the quality of received data. This numerical value can be directly correlated to bit error rate performance. The required test circuit can be implemented with discrete circuitry or in software within a microcomputer.

Eye Pattern — By using the modems digital output signals RCVDS, SYC, and A along with an added test circuit, the user can generate an oscilloscope quadrature eye pattern. This pattern displays the received signal as a group of dots in the baseband signal plane; hence, it is a graphic representation of modem performance.

ELECTRICAL CHARACTERISTICS

POWER REQUIREMENTS

Module	Voltage	Ripple	Maximum Current
T	+5 Vdc ±5% +12 Vdc ±5% -12 Vdc ±5%	100 mV p-p 50 mV p-p 50 mV p-p	38 mA 16 mA 48 mA
R1	+12 Vdc ±5% -12 Vdc ±5%	50 mV p-p 50 mV p-p	23 mA 16 mA
R2	+5 Vdc ±5% +12 Vdc ±5% -12 Vdc ±5%	100 mV p-p 50 mV p-p 50 mV p-p	64 mA 25 mA 78 mA

Maximum total power consumption approximately 3 watts.
Typical total power consumption approximately 2 watts.

DIGITAL INTERFACE

The R24 provides LS TTL or CMOS compatible logic levels that are functionally equivalent to EIA RS232/449 and CCITT V.24.

Input Logic	Allowed Input Voltage Levels
Low High	-12.0V to +0.8V Sinking <10 μA +4.0V to +5.0V Sourcing <10 μA

Digital inputs are directly CMOS compatible. Interfacing with standard TTL or low-power Schottky TTL requires an external pull-up resistor.

Output Logic	Allowed Output Voltage Levels
Low High	0.0V to +0.4V Sinking 0.36 mA +4.0V to +5.0V Sourcing 100 μA

Digital outputs are directly CMOS or low-power Schottky TTL compatible.

TRANSMISSION LINE INTERFACE

The R24 provides an analog interface that must generally be transformer coupled to ensure normal telephone line isolation. Through appropriate selection of transformers and other interface circuitry, the R24 can be configured to operate on leased or dial-up telephone lines, or on other special private networks. For the dial-up line interface, Rockwell offers an FCC registered module that allows direct connection to this network. For the leased line interface, only transformers with characteristics similar to those utilized on the R24 modem evaluation board are required for this connection.

The receiver and transmitter line interfaces are single-ended (non-transformer coupled) signals with the following characteristics:

Transmitter Output (Normal)

Output Impedance: 600 ohms ± 2%
Maximum output level: ≤ 0.0 dBm

Transmitter Output (Alternate) Low Impedance:

Output Impedance: 0 ohms (op amp output)

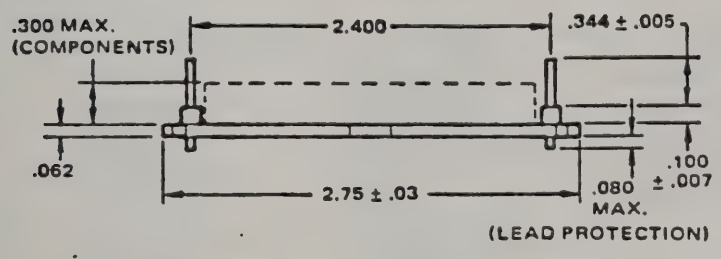
Maximum output level ≤ + 6.0dB

Note: This output for transformer loss compensation.

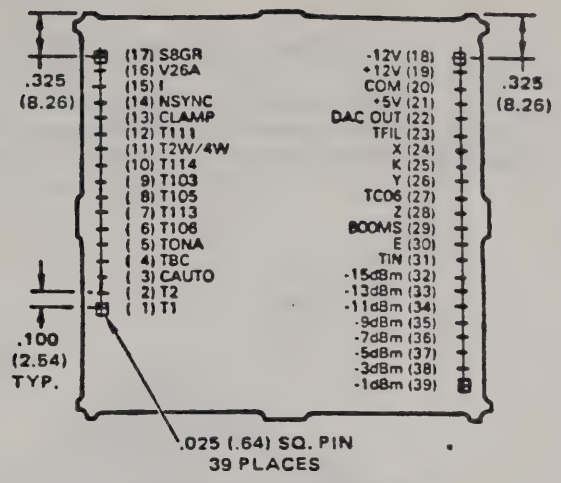
Receiver Input:

Input Impedance: 15.8K ohms ± 1%
Maximum Input Level: 0.0 dBm

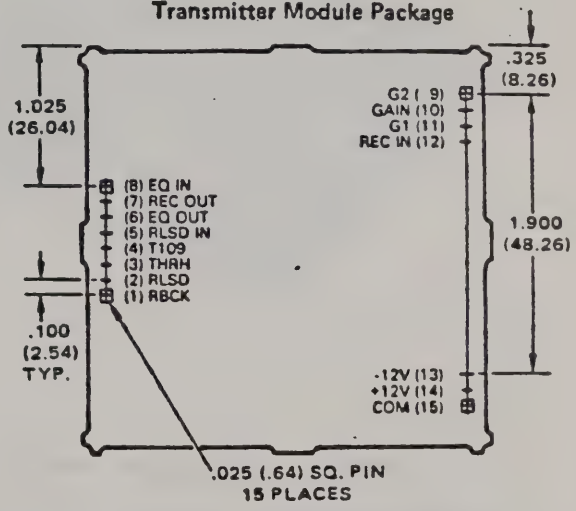
MECHANICAL SPECIFICATIONS



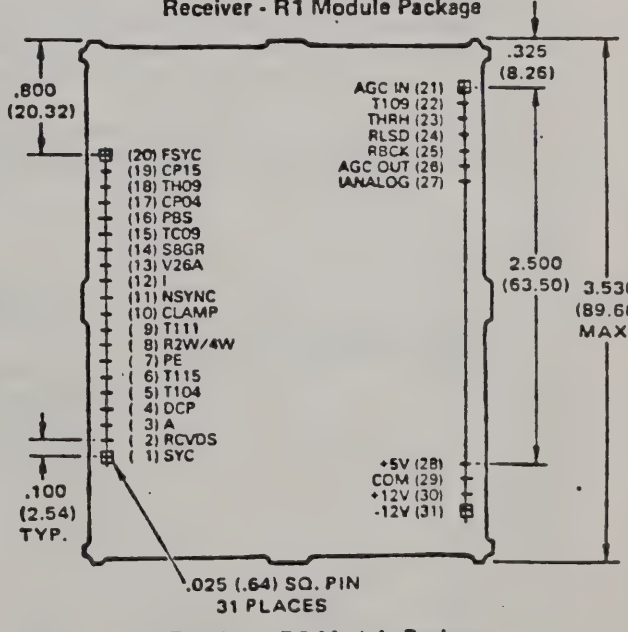
NOTE: This cross-section is common to all modules.



Transmitter Module Package



Receiver - R1 Module Package



Receiver - R2 Module Package

NOTES: 1) Dimensions in inches (millimeters).
2) Component side shown

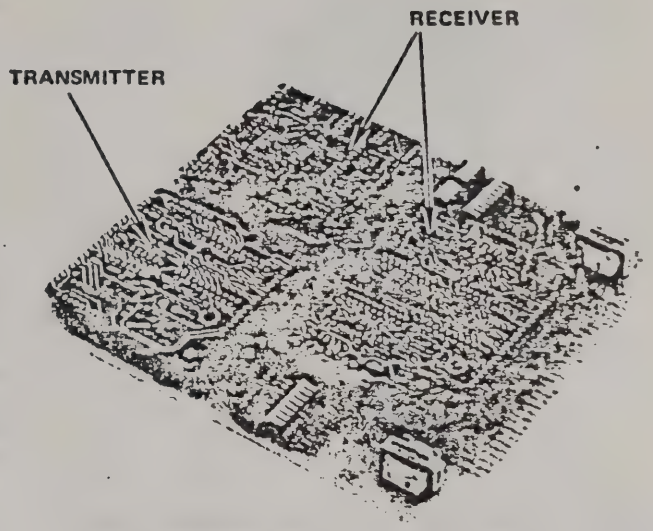
PRINTED CIRCUIT BOARD MOUNTING OPTIONS FOR THE R24 MODULES

ree methods of mounting are commonly used. Each configuration t certain distinct advantages.

Mounting Method	Type of Connection or Connector Used	Basic Advantage
Standard Flush PCB Component Mount	Wave Soldered Into Standard PCB Eyelets	Lowest Height Profile
Above Board Low Profile Socket	Connectors (SAE Series 3000 or Methode Series 1000) These Sockets are Wave Soldered Into Standard PCB Eyelets	Plug-in Capability at Low Cost
PCB Plug-in Sockets (Bullets)	Connectors (AMP Miniature Spring Sockets.) Pin Sockets are Individually Soldered Into PCB Eyelets	Lowest Profile for Plug-in Capability

R24 MODEM EVALUATION BOARD

To facilitate evaluation and design-in of the R24 modem for new and existing equipment designs, an R24 Modem Evaluation Board (R24MEB) is available — see below. The R24MEB can be easily combined with terminal systems for real-time performance evaluation.



ENVIRONMENTAL SPECIFICATIONS:

Operating temperature: 0°C to 60°C
Storage temperature: -40°C to +80°C
Relative humidity: to 95% (non-condensing)
Altitude: -200 to 10,000 feet (-61 meters to 3,049 meters)
Burn-In: 96 hours at 70°C

Order Information

When ordering, specify products as follows:

R24 — Set of 3 modules (T, R1, R2)
R24MEB — Modem Evaluation Board

The R24 transmitter function (R24-T module) and the R24 receiver function (R24-R1, R24-R2 modules) can be purchased separately. Contact your Rockwell Sales office or Anaheim to quote specific customer requirements.

R24 Modem Evaluation Board (R24MEB)

The Modem Evaluation Board is equipped with a standard 31 pin edge connector, control switches, output level jumper, and interface transformers. These features allow full control of the interface circuitry. In addition, this unit can be used directly in a U.S. leased line configuration.

The R24MEB is recommended for all first-time users to assist in their evaluation. Complete documentation is supplied with each initial R24MEB.

Micro Power

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TWX 910 591-1698

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Richardson, Texas 95080
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DATA SHEET

MODEL 488T

NOISE-CANCELING TRANSISTORIZED MICROPHONE

GENERAL

The Shure Model 488T Microphone is designed for clear, crisp, natural voice reproduction combined with a highly effective noise-canceling function. The microphone is FAA Certified for Aircraft application (TSO-C58).

Model 488T incorporates the patented Shure CONTROLLED MAGNETIC® Cartridge in a high-quality, extremely reliable, hand-held unit of professional design, small size, and light weight. The transistor amplier of the Model 488T is designed to match carbon microphone type input circuitry.

Noise cancellation in the Model 488T microphone is obtained through the combination of highly directional operation and superior discrimination against noise or unwanted sounds from a relatively distant source. The microphone rejects sounds originating at distances over 15 cm (6 inches). This means that engine noise, wind noise, propeller noise, noise from vibrating panels and all other sources are discriminated against.

The shaped frequency response of the microphone optimizes performance in the frequency range of 200 to 4,000 Hertz, further eliminating sounds outside of the desired frequency range and achieving proper control of those sounds within the desired voice range.

Microphone Features:

- Built-in transistor amplifier (powered by carbon microphone type circuit)
- Frequency response from 200 to 4,000 Hz, shaped for voice communications use
- Small, light, compact case for minimum space and maximum handling comfort
- Rugged leaf-type switch stands up under severe operating conditions and constant use
- High-impact ARMO-DUR® case—lighter and stronger than die-cast metal, comfortable to the touch in hot or cold weather
- Rugged and dependable under all operating conditions
- Long-life, neoprene-jacketed coil cord
- FAA Certified for Aircraft use
- Supplied with PJ-068 connector on cable

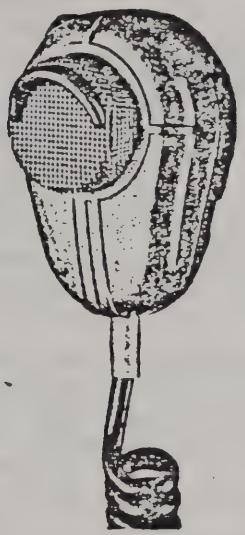
APPLICATIONS

The Model 488T Noise-Canceling Transistorized Microphone is designed to provide highly intelligible speech communication under all types of noise conditions. It is specifically designed for use in all kinds of commercial and private aircraft. The Model 488T is FAA Certified for Aircraft operation.

This microphone features distance discrimination that provides unparalleled intelligibility even when the operator cannot hear his own voice.

ACOUSTIC CONSIDERATIONS

The Model 488T microphone rejects noise through its inherent directional properties and discriminates



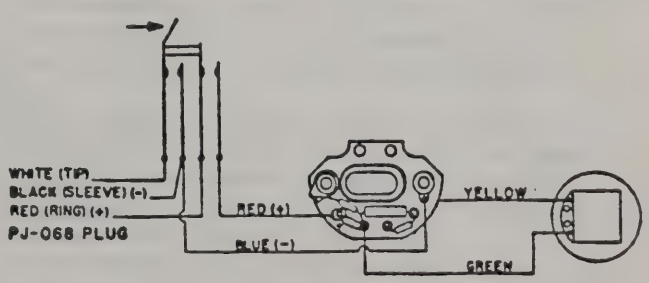
against unwanted sounds arriving from a distance in favor of sounds from a near source. The microphone operates on the pressure-gradient principle and has two sound entry ports, spaced a small distance apart.

In order to obtain the best performance with this microphone, it must be used as "close-talking." The lips should be as close to the microphone grille as possible (pressed against the rubber lip guard), with a distance of up to 25 mm (1 in.) from the grille providing the greatest discrimination between voice sounds and background noise.

CONNECTIONS

The Model 488T is a low-impedance transistor-amplified microphone with a three-conductor coiled-cord cable, an attached PJ-068 two-circuit phone plug, and a double-pole single-throw leaf-type switch to control the microphone circuit and an external relay or switching circuit. The RING (RED lead) is connected to the microphone circuit. The TIP (WHITE lead) controls the relay or switching circuit. The SLEEVE (BLACK lead) is common to the microphone and relay circuits.

The internal switch connections of the Model 488T are shown in Figure 1 and a typical external operating circuit is shown in Figure 2. The design parameters of



INTERNAL CONNECTIONS

FIGURE 1

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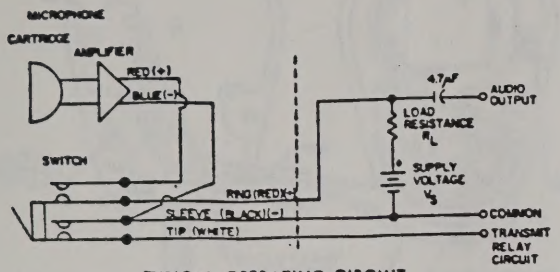
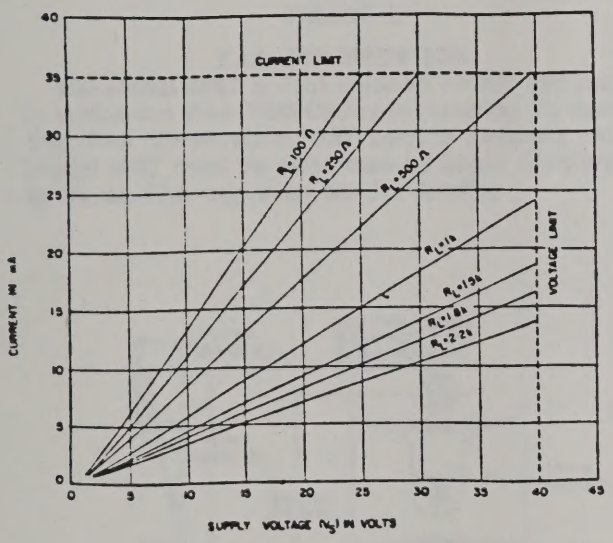
27A1343 (T8)

Printed in U.S.A.

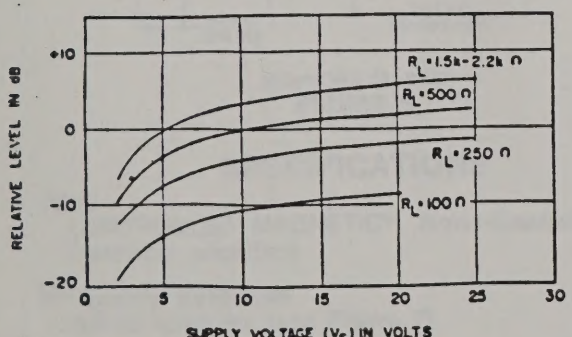
the operating circuit (supply voltage, load resistance, current, and sensitivity) may be selected using the curves shown in Figures 3 and 4. If, for instance, the available supply voltage is 16 Vdc and a current drain of 8 mA is desired, Figure 3 shows that a load resistance (R_L) of 1.5k is necessary. In Figure 4, it can be seen that with a supply voltage of 16 Vdc and a load resistance of 1.5k, the relative sensitivity is approximately +6 dB higher than the specified output level of −5 dB with 10 Vdc and a 500-ohm load (see Specifications).



TYPICAL OPERATING CIRCUIT
FIGURE 2



MAXIMUM VOLTAGE AND CURRENT LIMITS
FIGURE 3



SENSITIVITY AS A FUNCTION OF SUPPLY VOLTAGE AND LOAD RESISTANCE
FIGURE 4

CAUTION: The following should be observed to avoid damage to the Model 488T:

1. Supply voltage (V_S) must be between 2 and 40 Vdc. Voltages in excess of 40 Vdc may substantially reduce the life of the microphone amplifier. Voltages less than 2 Vdc are not sufficient for microphone amplifier operation (although no damage will result).
2. The top (dashed) line of Figure 3 determines the maximum allowable current (dissipation limit) for various combinations of supply voltages and load resistances.
3. Make certain proper polarity is followed for the phone plug RING (+) and SLEEVE (−) circuits as shown in Figures 1 and 2. In mobile and aircraft equipment installations, vehicle battery polarity verification is extremely important.

MOUNTING

The Model 488T is supplied with a mounting bracket to provide a snap-in hang-up for the microphone when not in use. The bracket has mounting holes with clearance for No. 8 screws (see Figure 6).

OPERATION

No special precautions beyond ordinary care are necessary in operating the 488T microphone. It will operate satisfactorily under most conditions of temperature and humidity. Dropping the microphone or other severe mechanical shocks should be avoided.

MODULATION LEVEL ADJUSTMENT

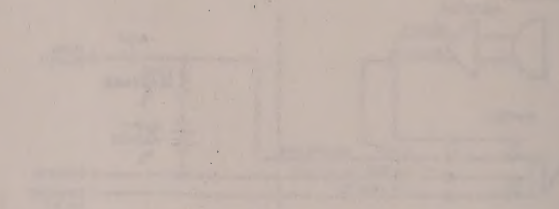
For optimum operation of your transmitter, it is important to have proper modulation. Proper modulation will give undistorted transmissions, greater range, and less interference from static.

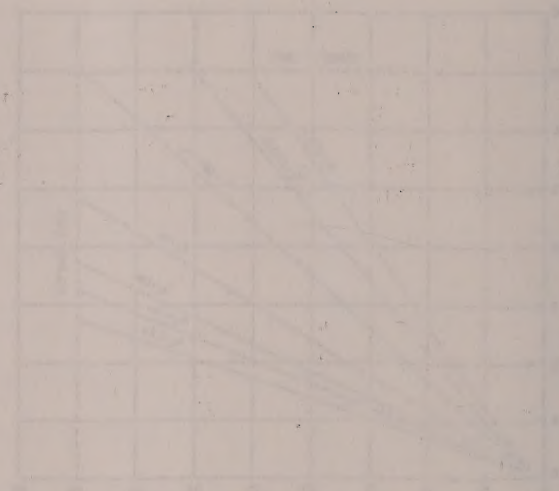
To obtain proper modulation, the following points should be considered:

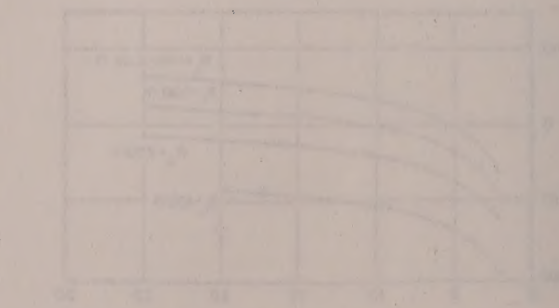
1. TALK CLEARLY AT NORMAL SPEAKING LEVELS. TALK DIRECTLY INTO THE GRILLE OF THE 488T, WITH THE LIPS AS CLOSE TO THE GRILLE AS COMFORT WILL PERMIT, WITH A DISTANCE OF APPROXIMATELY 6 MM (¼ IN.) GIVING THE ULTIMATE IN DISCRIMINATION AGAINST UNWANTED ACOUSTIC NOISES. USE THE RUBBER LIP GUARD FOR PROPER PLACEMENT OF MOUTH.
2. In the majority of applications, the 488T will work properly when simply plugged into the transmitter. If you want to check modulation or if you suspect improper modulation level, read points a and b.
   a. When using the 488T to replace another make or model microphone, it is desirable to check the modulation to make sure it is set to the transmitter manufacturer's specifications. This is because the 488T may have more or less output than the previous microphone, depending upon the specific transmitter. The modulation control in aircraft transmitters will always provide proper adjustment when using the 488T. This check should always be made when installing any new microphone and should only be made by qualified persons.
   b. If the 488T has excess output, resulting in over modulation or distortion, the gain of the 488T transistor amplifier may be reduced 6 dB.

To modify the 488T for reduced output, proceed as follows:

1. Remove the three No. 5-40 round head screws and washers from the back of the microphone case. (Caution: the microphone cartridge is spring-loaded and care must be taken to hold the two halves of the microphone case firmly together.)
2. Separate the case front and back. See Figure 5.
3. Note transistor amplifier board at the bottom of the front case half. Clip leads of the indicated resistor at the lower right hand side of the transistor amplifier board. This reduces the output level approximately 6 dB.







To re-assemble microphone proceed as follows:

1. Be certain that the cartridge shield retaining springs are in proper position.
2. Place case back on case front and firmly press cases together; fasten with the three No. 5-40 screws and washers previously removed.

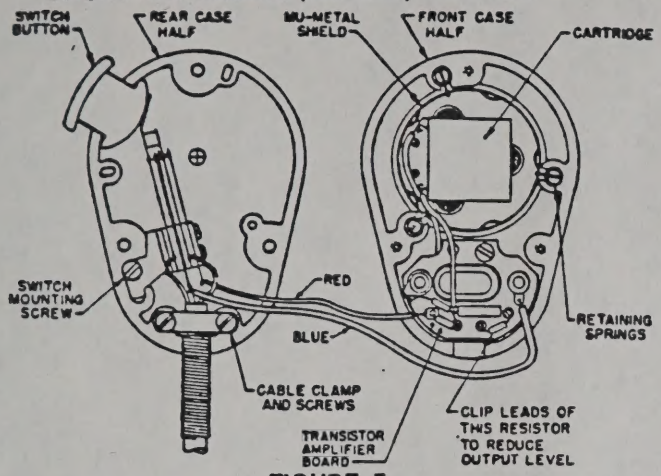
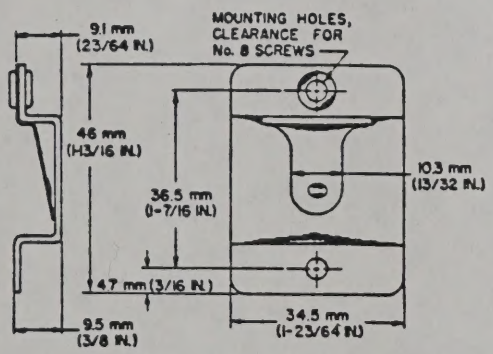


FIGURE 5

FAA CERTIFICATION

The Model 488T is FAA certified for Aircraft use and is within the FAA TSO-C58 requirements. To maintain this FAA certification, any service required for the Model 488T must be performed by Shure Brothers Inc. or by an FAA approved service facility.


9.1 mm (23/64 IN.)
MOUNTING HOLES, CLEARANCE FOR No. 8 SCREWS
46 mm (1 13/16 IN.)
36.5 mm (1-7/16 IN.)
10.3 mm (13/32 IN.)
4.7 mm (3/16 IN.)
9.5 mm (3/8 IN.)
34.5 mm (1-23/64 IN.)

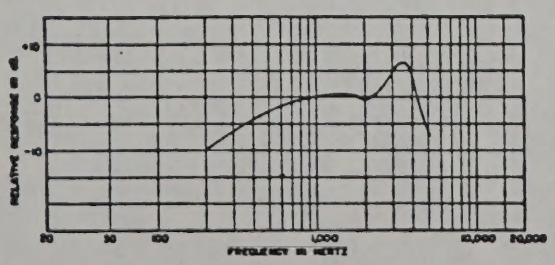
MOUNTING BRACKET

FIGURE 6

SPECIFICATIONS

Type
CONTROLLED MAGNETIC®, Noise-Canceling (with transistor amplifier)

Frequency Response
200 to 4,000 Hz (see Figure 7)



TYPICAL FREQUENCY RESPONSE

FIGURE 7

Load Impedance Range
100 to 2,200 ohms (see Figures 3 and 4)

Output Level (at 1,000 Hz, 5/16 in.)
−5.0 dB (.560 V) with 10 Vdc, 500-ohm load
(0 dB = 1 volt per 100 microbars) (See Figure 4)

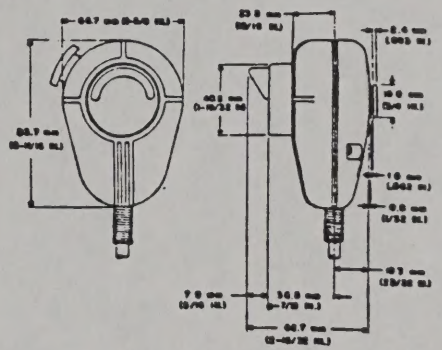
DC Supply Voltage and Current
2 to 40 Vdc (see Figure 3)

Switch
Double-pole, single-throw, leaf-type, push-to-talk

Cable
Nondetachable, 1.7m (5½ ft), 3-conductor, tinsel, neoprene-jacketed, coil cord with PJ-068 2-circuit phone plug on equipment end

Case
High-impact ARMO-DUR® with perforated steel grille and rubber lip guard

Dimensions
See Figure 8



OVERALL DIMENSIONS

FIGURE 8

Net Weight
340 grams (12 oz)

Packaged Weight
510 grams (18 oz)

Certification
FAA certified for Aircraft use within TSO-C58

FURNISHED ACCESSORY

Mounting Bracket RK6MB

REPLACEMENT PARTS

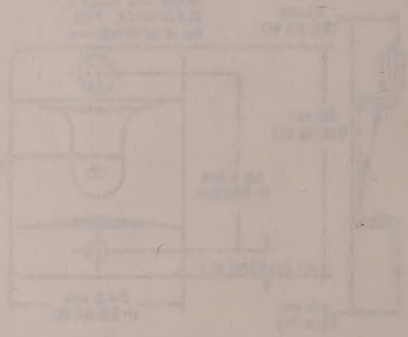
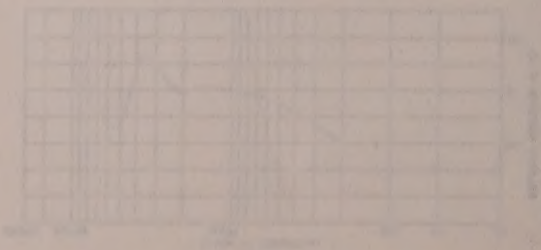
Cartridge Assembly R88T
Switch RK24S
Cable C22C
Case Front and Back RK23C
Preamplifier RK11A

GUARANTEE

This Shure product is guaranteed in normal use to be free from electrical and mechanical defects for a period of one year from date of purchase. Please retain proof of purchase date. This guarantee includes all parts and labor. This guarantee is in lieu of any and all other guarantees or warranties, express or implied, and there shall be no recovery for any consequential or incidental damages.

SHIPPING INSTRUCTIONS

Carefully repack the unit and return it prepaid to:

Shure Brothers Incorporated
Attention: Service Department
1501 West Shure Drive
Arlington Heights, Illinois 60004

If outside the United States, return the unit to your dealer or Authorized Shure Service Center for repair. The unit will be returned to you prepaid.